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ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

Induced Single-Flush Synchronous Growth of Shrub Live Oak[1]

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When shrub live oak is grown under favorable greenhouse conditions, the plants generally grow nonsynchronously after a common flush of growth in the spring. The results of this study indicate that it is possible to induce a single flush of synchronous growth from nonsynchronously growing plants by clipping terminal shoots, since release of lateral buds and subsequent regrowth was not affected by the stage of shoot development at time of clipping. The technique should be useful in studies to determine the effect of stage of shoot development on the effectiveness of foliage-applied herbicides.

Keywords: *Quercus turbinella*, foliage-applied herbicides, synchronous growth.

Under greenhouse conditions shrub live oak (*Quercus turbinella* Greene) generally grows in a rhythmic pattern in which a flush of growth is followed by a period of temporary dormancy. The cycle continues as long as the plant is provided with the necessary conditions for growth. This type of growth is sometimes referred to as episodic (Romberger 1963). Shoots on different plants or on the same plant grow nonsynchronously, that is, they do not necessarily grow at the same time.

Unpruned greenhouse seedlings of shrub live oak develop into a relatively unbranched plant form characteristic of plants with strong apical dominance. This may result from the production of relatively large amounts of auxin in the apex, and the balance and interactions of auxin, ethylene, and cytokinin (Leopold 1955, Galston and Davies 1970, Kozlowski 1971). If shoots are clipped, the top lateral bud or buds are released, and shoots from these buds grow rapidly. This is known as compensatory growth of lateral buds (Jacobs and Bullwinkel 1953). The inhibition of lateral buds before clipping is an example of correlated inhibition (Romberger 1963).

Since the growth pattern of shrub live oak is characterized by alternate periods of temporary dormancy and growth, it is possible that the stage of shoot development at time of clipping has an effect on the release of lateral buds and subsequent growth

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of lateral shoots. The question investigated in this study is whether clipping temporarily dormant shoots is equivalent to clipping actively growing shoots with respect to the release of lateral buds. If their release is not affected by stage of development of the clipped terminal, it could mean that temporarily dormant shoots have no greater inhibiting effect on lateral buds than shoots undergoing a flush of growth. From a practical standpoint it should then be possible to induce a single flush of synchronous growth from nonsynchronously growing plants. Such a technique would be useful in studies to determine the effect of stage of shoot development on the effectiveness of foliage applications of herbicides on shrub live oak, or in other studies where synchronous growth is desired. The response of shrub live oak to terminal clipping of dormant or actively growing shoots may also be of interest to wildlife biologists concerned with the response of shrubs to browsing.

Methods

Experiment 1

In the first of two experiments, 3-year-old potted shrub live oak plants were cut back to 6 inches and allowed to regrow. When the plants were about 16 inches tall, shoots were selected that were either temporarily dormant or actively growing. Shoots in the temporarily dormant condition had mature hardened leaves and a temporarily dormant terminal bud. Actively growing shoots were in the late stem elongation stage, and were elongating rapidly (fig. 1).

The plants had multiple shoots, but only one shoot was chosen for study on each plant. There were 8 shoots in the temporarily dormant stage and 11 shoots in the actively growing stage. The dormant shoots were clipped below the third hardened leaf

Figure 1.—Two stages of shoot growth of shrub live oak: (Left) temporarily dormant shoots, and (right) actively growing shoots in the late stem elongation stage.

from the top. The actively growing shoots were clipped immediately below the third hardened leaf of the previous flush. The growth of lateral shoots following clipping was measured as increase in shoot length. After the regrowth shoots completed a flush of growth, they were harvested and weighed fresh; only one lateral shoot developed from each clipped shoot.

Experiment 2

The second experiment was conducted with 5-year-old potted plants that had been pruned many times. Actively growing shoots in the late stem elongation stage and temporarily dormant shoots were selected from a large group of plants. Each stage of shoot growth was represented by 28 shoots. In most cases a plant contained only one experimental shoot, but in a few cases it was necessary to use two shoots per plant. The clipping procedure was the same as in the first experiment. About half of the clipped stems developed just one lateral regrowth shoot; the others developed two to four laterals, the top one being the lead shoot and the lower ones growing progressively less. When more than one lateral shoot developed on a clipped shoot, their combined lengths and final fresh weights were used as measures of regrowth.

Results and Discussion

Lateral shoot growth of shrub live oak was the same after either temporarily dormant or actively growing shoots were clipped, measured either as increase in length (fig. 2) or as final fresh weight of regrowth shoots:

	Experiment 1[3] (g)	Experiment 2[3] (g)
Temporarily dormant	1.24 ± 0.43	2.15 ± 0.49
Actively growing	1.17 ± .37	2.47 ± .49

The regrowth shoots were harvested and weighed after they completed a flush of growth. The stage of

[3] The ± in tabulation indicates mean ± $t_{.05}$ × standard error.

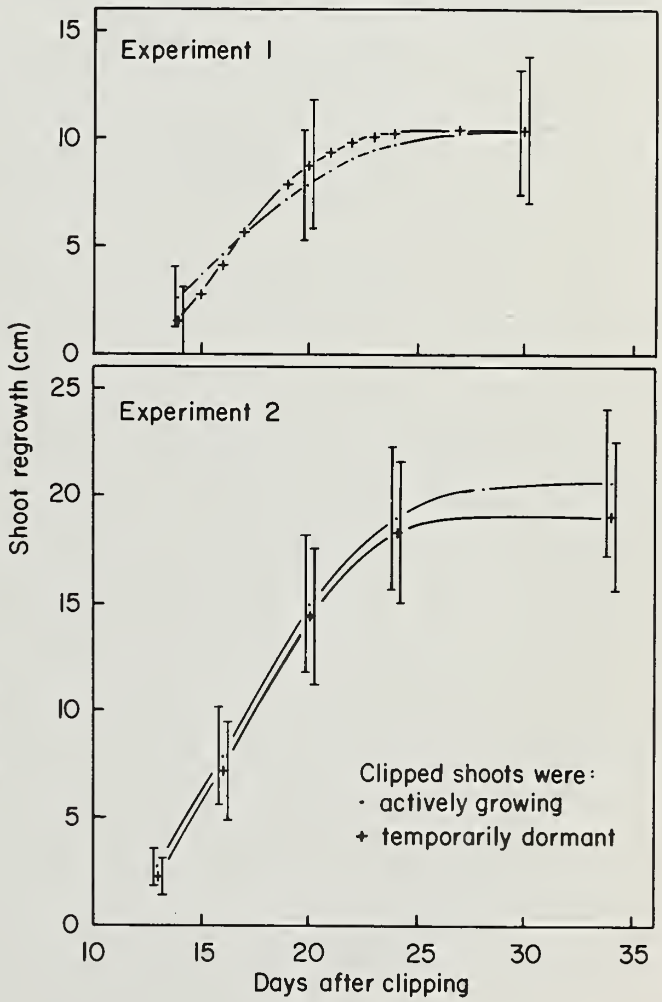

Figure 2.—Shoot regrowth of shrub live oak after terminal clipping of temporarily dormant and actively growing shoots. The vertical lines represent the 95% confidence limits of the population means.

shoot development at the time of clipping did not significantly affect regrowth from released lateral buds. This suggests, for shrub live oak, that an actively growing shoot has no greater inhibiting effect on lateral buds than a temporarily dormant shoot. The results also indicate that the upward mobilization of nutrients and perhaps growth substances to the new flush of growth did not stimulate lateral shoots to a level above that caused by clipping temporarily dormant shoots, which were presumably transporting foodstuffs downward.

Elements in common to both types of shoots before they were clipped were the mature hardened leaves above and below the point of excision. It is possible that these mature leaves exerted the major influence on the lateral buds (Leopold 1964, Wareing and Phillips 1970).

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